Financial considerations in a small open economy model for Mexico

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Two comments

- This is work in progress.
- The views expressed here are the author's only and should not be interpreted as reflecting those of Banco de México.

Financial considerations in monetary policy

- Quadrini (2011) FRB of Richmond Economic Quarterly

  "There is a long and well-stablished tradition in macroeconomics of adding financial market frictions in standard macroeconomic models and showing the importance of the financial sector for business cycle fluctuations (...) Although these studies had an impact in the academic field, formal macroeconomic models used in policy circles have mostly developed while ignoring this branch of economic research."

- The financial crisis and its aftermath brought about new challenges for the making of macroeconomic policy in general and of monetary policy in particular.

The Mexican case

- Not much has been written in the context of DSGE models for monetary policy purposes that address these questions for the Mexican case.
- Some stylized facts to focus on:
  1. Credit flows are procyclical and interest rate spreads are countercyclical.
  2. The baking sector works under monopolistic competition and interest rates are sticky (Negrin et al. (2012) and Mier-y-Terán (2013), respectively).
  3. A great percentage of resources collected by firms finance working capital (Banxico (2013), Castellanos (2012), CNBV (2012)).

Credit flows are procyclical

New loans vs output:

Firms

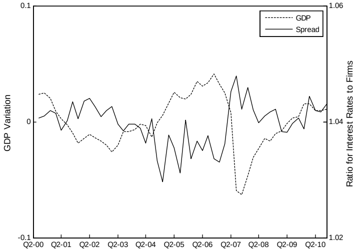
Households

Correlations:	
$\rho(new\_loans\_firms, y)$	0.58
$\rho(new\_loans\_HH, y)$	0.56

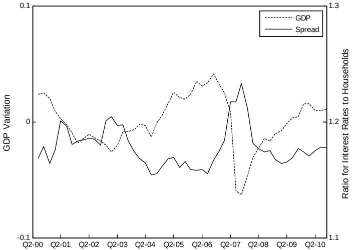
Lending rate spreads are countercyclical

Difference between lending rates and reference rate vs output:

Firms



Households



Correlations:	
$\rho(diff\_lendingrate\_firms, y)$	-0.57
$\rho(diff\_lendingrate\_HH, y)$	-0.65

The Mexican case

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In this paper...

- Main goals at this stage:
  - **To develop an operational small open economy (SOE) model for the Mexican economy that incorporates these features and successfully accounts for the data.**
  - **To use it to analyze the transmission mechanism of some shocks into the economy.**

- Type of model:
  - Standard New-keynesian SOE model.
  - Featuring linkages between real and financial sectors and imperfections in the intermediation of resources:
    - Credit demand frictions: collateral constraints with a working capital channel.
    - Credit supply frictions: banking sector working under monopolistic competition and sticky interest rates.

So far...

- Our contribution:
  - To estimate an operational DSGE model that considers both credit demand and credit supply frictions for the Mexican economy.
  - To analyze the role of a working capital channel embedded in collateral constraints in the transmission mechanism of banking shocks into the economy.
- Main results:
  - The model is able to reproduce some properties of business cycles.
  - Preliminary estimation shows that the inclusion of working capital is relevant. This ingredient has non-trivial effects in the propagation of different shocks and the reproduction of the credit cycle.
  - Sectorial banking shocks may have aggregate effects in a context where monetary policy reacts to offset them (is monetary policy too blunt?).

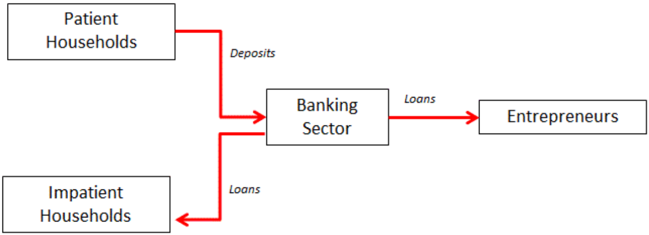
Model's main characteristics

- New-keynesian SOE model (Adolfson (2007), successfully adapted to other SOE countries):
  - Real rigidities: habit persistence, capital utilization, investment adjustment costs.
  - Nominal rigidities: price and wage stickiness.
  - Incomplete exchange rate pass-through (according to empirical evidence in Mexico, Cortés (2013)).
- Financial frictions:
  - Limited enforceability of contracts give rise to collateral constraints (Iacovello (2005)).
- **Working capital channel associated to collateral constraints (as in Mendoza (2010) and Jermann and Quadrini (2011)).**

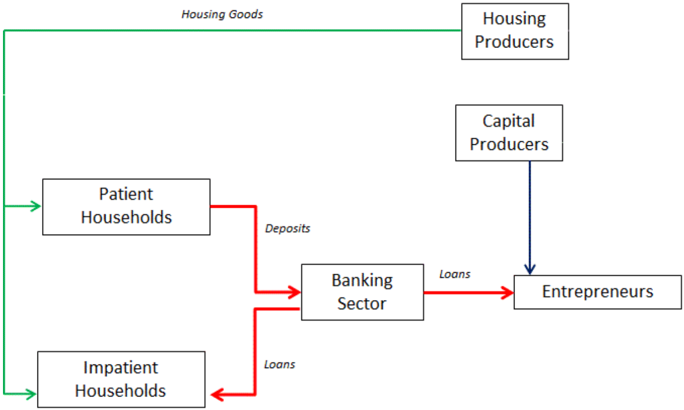
Model's main characteristics (contd.)

- 3 agents:
  - Patient households: consume, housing, differentiated work, save
  - Impatient households: consume, housing, differentiated work, borrow
  - Entrepreneurs: consume, produce intermediate goods out of capital and labor, borrow
- 2 assets:
  - housing goods (for households)
  - capital good (for entrepreneurs)
- Production side pretty standard of a SOE model

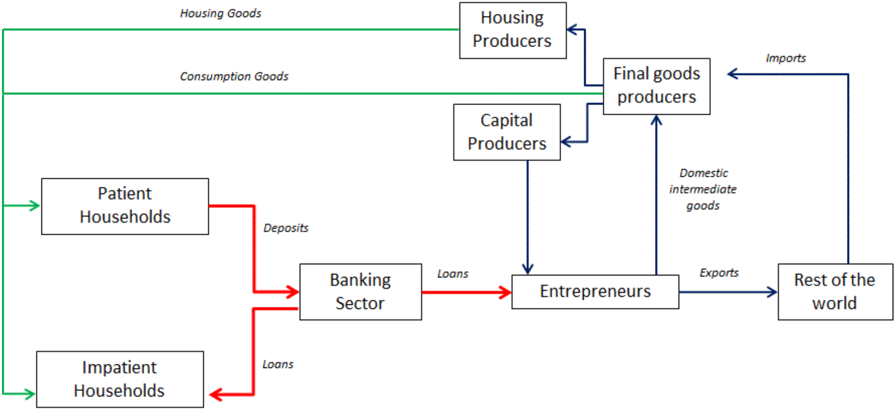
Real and financial linkages in the model



Real and financial linkages in the model (contd.)



Real and financial linkages in the model (contd.)



Patient households

- Patient household (i) chooses consumption, stock of housing and savings to solve the following problem:

$$\max E_0 \sum \beta_P^t \left[\varepsilon_t^u \frac{(c_t^P(i) - hc_{t-1}^P(i))^{1-\sigma_c}}{1-\sigma_c} + \varepsilon_t^x \frac{\chi_t^P(i)^{1-\sigma_\chi}}{1-\sigma_\chi} - \varepsilon_t^n \frac{n_t^P(i)^{1+\sigma_n}}{1+\sigma_n} \right]$$

s.t.

$$\begin{aligned} P_t c_t^P(i) + P_t^\chi \left(\chi_t^P(i) - (1-\delta_\chi)\chi_{t-1}^P(i) \right) + D_t(i) \quad \leq & \quad \left(1 - \Phi_P\left(\pi_{w,t}^P\right)\right) P_t w_t^P(i) n_t^P(i) \\ & + R_{D,t-1}^H D_{t-1}(i) - T_t(i) + \Pi_t^P(i) \end{aligned}$$

FOCs

Impatient Households

- Impatient household (i) chooses consumption, stock of housing, and loans in order to solve the following problem:

$$\max E_0 \sum \beta_I^t \left[\varepsilon_t^u \frac{(c_t^I(i) - hc_{t-1}^I(i))^{1-\sigma_c}}{1-\sigma_c} + \varepsilon_t^x \frac{\chi_t^I(i)^{1-\sigma_\chi}}{1-\sigma_\chi} - \varepsilon_t^n \frac{n_t^I(i)^{1+\sigma_n}}{1+\sigma_n} \right]$$

s.t.

$$\begin{aligned} P_t c_t^I(i) + P_t^\chi \left(\chi_t^I(i) - (1-\delta_\chi)\chi_{t-1}^I(i) \right) + R_{L,t-1}^H L_{t-1}^H(i) \quad \leq \quad & \left(1 - \Phi_I\left(\pi_{w,t}^I\right)\right) P_t w_t^I(i) n_t^I(i) \\ & + L_t^H(i) - T(i) \end{aligned}$$

$$R_{L,t}^H L_t^H(i) \leq m_t^H E_t \left[P_{t+1}^\chi (1-\delta_\chi) \chi_t^I(i) \right]$$

FOCs

Entrepreneurs

- Representative entrepreneur chooses consumption, capital, capital utilisation, labor and loans in order to solve the following problem:

$$\max E_0 \sum \beta_E^t \left[\varepsilon_t^u \frac{(c_t^E(i) - hc_{t-1}^E(i))^{1-\sigma_c}}{1-\sigma_c} \right]$$

s.t.

$$y_t^w(i) = A_t \left[u_t(i) k_{t-1}(i)\right]^{\alpha} n_t(i)^{1-\alpha}$$

$$R_{L,t}^F L_t^F(i) + w_t n_t(i) \leq m_t^F E_t \left[P_{t+1}^k (1-\delta_k) k_t(i) \right]$$

$$P_t c_t^E(i) + P_t w_t n_t(i) + P_t^k \left(k_t(i) - (1-\delta_k) k_{t-1}(i)\right) + P_t \psi(u_t(i)) k_{t-1}(i) + R_{L,t-1}^F L_{t-1}^F(i) \leq P_t^w y_t^w(i) + L_t^F(i)$$

FOCs

Working capital channel

- The first order condition of labor for the entrepreneur is:

$$\frac{\lambda_{c,t}^{E} + \mu_t^{E}}{\lambda_{c,t}^{E}} w_t = \left[(1-\alpha) P_t^{w} A_t \left(u_t k_{t-1} \right)^{\alpha} \left(n_t \right)^{-\alpha} \right]$$

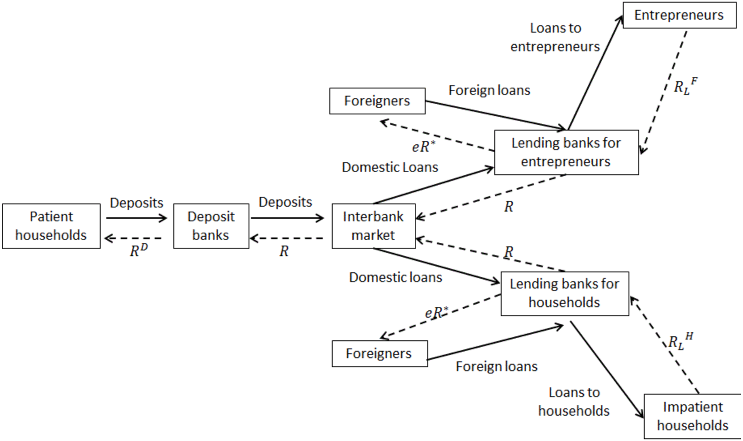
where $\lambda_{c,t}^{E}$ and μ_t^{E} are the Lagrangian multipliers of the budget constraint and the collateral constraint, respectively

- If financial constraints are relaxed: μ_t^{E} gets smaller $\Rightarrow$ lower labor costs $\Rightarrow$ at the margin, higher demand for labor.
- The opposite would happen if the financial constraints are tightened.

Banking sector

- Follows Gerali et al. (2011):
  - Monopolistic competition: spreads between active and passive rates and the reference rate.
  - Sticky interest rates.
  - Abstracts from bank's financial soundness considerations.

Credit flows

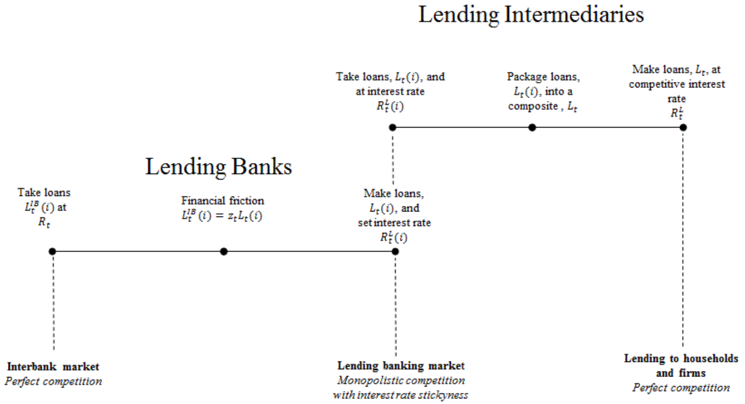


Credit flows (contd.)

- In order to illustrate the structure behind the banking system, we present the lending flow of credit (the structure is similar for borrowing flow).
- Two types of financial intermediaries:
  1. *Lending banks:*
     1. Operations: Obtain resources from the interbank market and use them to make loans at differentiated interest rates.
     2. Features: Monopolistic competition and interest rates stickiness.
  2. *Lending intermediaries:*
     1. Operations: They receive resources, package them and gives loans to households and firms.
     2. Features: perfect competition.

Credit flows (contd.)

Credit flow: from interbank market to real sector.



Credit flows (contd.)

- When carrying resources from the interbank market, the flow of credit faces an exogenous **financial frictions**:

$$L_t^j(i_L^j) = z_{L,t}^j L_{IB,t}^j(i_L^j)$$

- Every period each **lending bank** receives a signal about its ability to set their price:
  - With probability θ_L it sets their interest rates to $R_{L,t-1}^j$.
  - With probability $1-\theta_L$ they set its optimal interest rate, $R_t^{new}(i_L^j)$, thus they must solve:

$$\max_{R_{L,t}^{j,new}} E_t \sum_{s=0}^{\infty} \theta_D^s \beta_I^{S+1} \Lambda_{t,t+s+1}^p \left[R_{L,t}^{j,new}(i_L^j) L_{t+s}^j(i_L^j) - R_{t+s} L_{IB,t+s}^j(i_L^j) \right]$$

- **Lending intermediaries** solve:

$$\max_{L_t(i_L)} R_{L,}^j L_t^j - \int_0^1 R_{L,t}^j(i_L^j) L_t(i_L) di_L^j$$

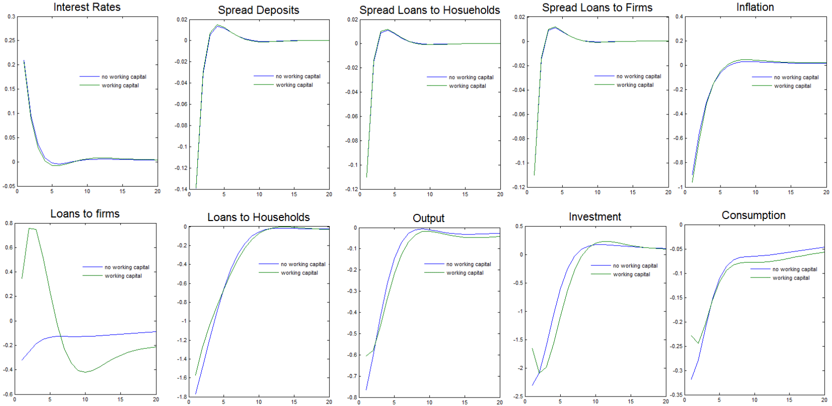
$$s.t.\ L_t = \left[\int_0^1 L_t^j(i_L^j)^{\frac{1}{1+\mu_L^j}} di_L^j \right]^{1+\mu_L^j}$$

The model vs the data

Unconditional Moments

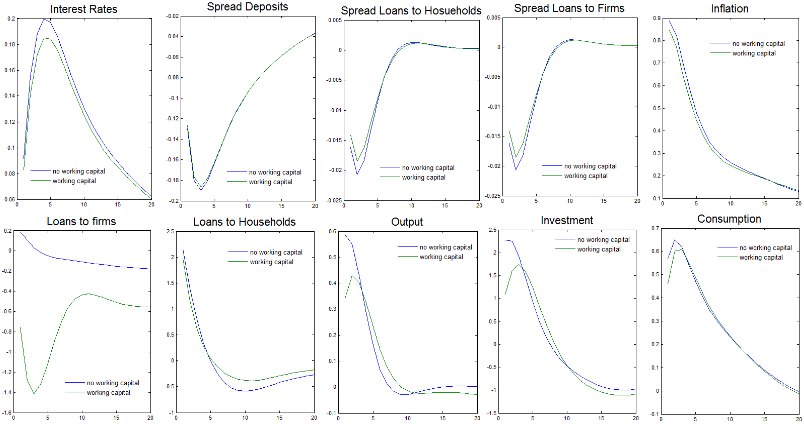
	Data	Model		Data	Model
$\sigma(\tilde{y})$	2.81	2.73	$\rho((y_{H^*} - y_F)/\tilde{y}, \tilde{y})$	−0.33	−0.23
$\sigma(c)/\sigma(\tilde{y})$	1.52	1.59	$\rho(R^D/R, \tilde{y})$	−0.23	−0.18
$\sigma(i_k + i_\chi)/\sigma(\tilde{y})$	3.28	4.01	$\rho(R_L^H/R, \tilde{y})$	−0.69	0.002
$\sigma(y_{H^*})/\sigma(\tilde{y})$	2.35	2.72	$\rho(R_L^F/R, \tilde{y})$	−0.65	−0.02
$\sigma(y_F)/\sigma(\tilde{y})$	2.70	2.64	$\rho(\Delta L^H, \tilde{y})$	0.57	0.07
$\sigma(RER)/\sigma(\tilde{y})$	3.92	1.20	$\rho(\Delta(L^F + wn), \tilde{y})$	0.62	0.13
$\sigma(R^D/R)/\sigma(\tilde{y})$	0.18	0.20			
$\sigma(R_L^H/R)/\sigma(\tilde{y})$	0.20	0.16			
$\sigma(R_L^F/R)/\sigma(\tilde{y})$	0.04	0.08			

IRF to a monetary policy shock



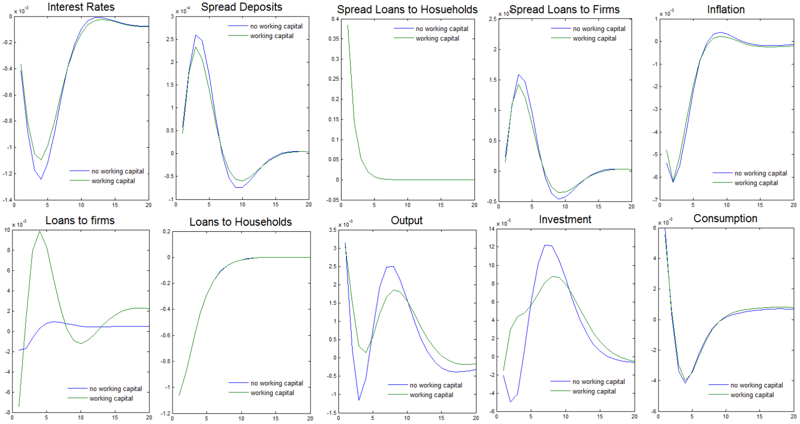
Working Capital

IRF to a banking shock in deposits



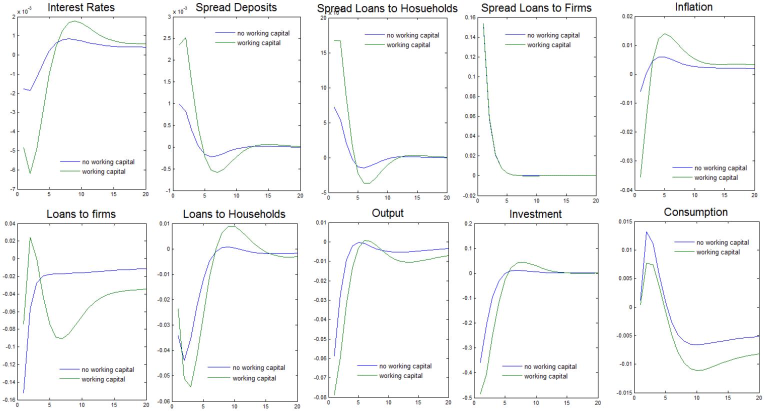
Working Capital

IRF to bank lending shock (households)



Working Capital

IRF to bank lending shock (firms)



Working Capital

What have we learned so far?

- Estimation: adding a working capital channel helps to match the model to the data.
- We have carefully inspected the implications of incorporating a working capital channel in a model with collateral constraints. The interaction between both frictions could dampen the volatility of variables in reaction to some shocks.
- The monetary policy rate could be a blunt instrument to address the effects of sectorial banking shocks.

Next steps

- To improve upon the estimation/calibration of the model.
- To extend the modelling of the banking sector: to introduce capital in bank's balance sheets.
  - Allow for a better characterization of the shocks arising within the banking sector.
  - Allow for bank's financial soundness considerations within our setup: macroprudential tool (capital adequacy ratio) would emerge that allows to consider the coexistence of monetary and macroprudential policies.

- Consumption goods:

$$\lambda^P_{c,t} = \varepsilon^u_t \frac{(c^P_t - hc^P_{t-1})^{-\sigma_c}}{P_t}$$

- Deposits:

$$\lambda^P_{c,t} = E_t \left\{ \frac{\beta_P R^H_{D,t} \lambda^P_{c,t+1}}{\pi_{t+1}} \right\}$$

- Housing goods:

$$\varepsilon^{\varkappa}_t (\chi^P_t)^{-\sigma_\chi} - \lambda^P_{c,t} P^\chi_t + \beta_P \lambda^P_{c,t+1} (1 - \delta_\chi) P^\chi_{t+1} = 0$$

- Consumption goods:

$$\lambda^{I}_{c,t} = \varepsilon^{u}_{t} \frac{(c^{I}_{t} - hc^{I}_{t-1})^{-\sigma_c}}{P_t}$$

- Loans:

$$\frac{E_t\left\{\lambda^{I}_{c,t+1}\right\}}{\lambda^{I}_{c,t}} = \frac{1}{\beta_I R^{H}_{L,t}}\left[1 - \frac{\mu^{H}_{t}}{\lambda^{I}_{c,t}} R^{H}_{L,t}\right]$$

- Housing goods:

$$\frac{\varepsilon^{\varkappa}_{t}(\chi^{I}_{t})^{-\sigma_\chi}}{P^{\chi}_{t}} - \lambda^{I}_{c,t} + \mu^{H}_{t} m^{H}_{t} E_t\left\{\pi^{\chi}_{t+1}\right\}(1-\delta_\chi) + \beta^{I}\lambda^{I}_{c,t+1}(1-\delta_\chi)\pi^{\chi}_{t+1} = 0$$

main

- Comsumption goods

$$\lambda^E_{c,t} = \varepsilon^u_t \frac{(c^E_t - hc^E_{t-1})^{-\sigma_c}}{P_t}$$

- Loans:

$$\frac{E_t\left\{\lambda^E_{c,t+1}\right\}}{\lambda^E_{c,t}} = \frac{1}{\beta_E R^F_{L,t}}\left[1 - \frac{\mu^F_t}{\lambda^E_{c,t}} R^F_{L,t}\right]$$

- Labor demand:

$$w_t\left(\lambda^E_{c,t} + \mu^F_t\right) = \lambda^E_{c,t}\left[(1-\alpha)\, P^w_t A_t \left(u_t k_{t-1}\right)^{\alpha} (n_t)^{-\alpha}\right]$$

- Capital utilization:

$$P_t \Psi'(u_t) = \alpha P^w_t A_t \left(u_t(i) k_{t-1}\right)^{\alpha-1} (n_t)$$

- Capital demand:

$$\lambda^E_{c,t} - \mu^F_t m^F_t (1-\delta_k) E_t\left\{\pi^k_{t+1}\right\} = \beta_E E_t\left\{\lambda^E_{c,t+1}\left[\begin{array}{c} \frac{P^W_{t+1}}{P^k_{t+1}}\left(\alpha \frac{y_{w,t}}{k_t}\right) \\ +(1-\delta_k)\frac{P^k_{t+1}}{P^k_t} - P_{t+1}\left(\frac{\Psi(u_t)}{P^k_t}\right) \end{array}\right]\right\}$$